Mastopexy for breast ptosis: Utility outcomes of population preferences

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BACKGROUND: Breast ptosis can occur with aging, and after weight loss and breastfeeding. Mastopexy is a procedure used to modify the size, contour and elevation of sagging breasts without changing breast volume. To gain more knowledge on the health burden of living with breast ptosis requiring mastectomy, validated measures can be used to compare it with other health states.

OBJECTIVE: To quantify the health state utility assessment of individuals living with breast ptosis who could benefit from a mastopexy procedure; and to determine whether utility scores vary according to participant demographics.

METHODS: Utility assessments using a visual analogue scale (VAS), time trade-off (TTO) and standard gamble (SG) methods were used to obtain utility scores for breast ptosis, monocular blindness and binocular blindness from a sample of the general population and medical students. Linear regression and the Student's *t* test were used for statistical analysis; $P < 0.05$ was considered to be statistically significant.

RESULTS: Mean ($\pm$ SD) measures for breast ptosis in the 107 volunteers (VAS: 0.80 ± 0.14 ; TTO: 0.87 ± 0.18 ; SG: 0.90 ± 0.14) were significantly different ($P < 0.0001$) from the corresponding measures for monocular blindness and binocular blindness. When compared with a sample of the general population, having a medical education demonstrated a statistically significant difference in being less likely to trade years of life and less likely to gamble risk of a procedure such as a mastopexy. Race and sex were not statistically significant independent predictors of risk acceptance.

DISCUSSION: For the first time, the burden of living with breast ptosis requiring surgical intervention was determined using validated metrics (ie, VAS, TTO and SG). The health burden of living with breast ptosis was found to be comparable with that of breast hypertrophy, unilateral mastectomy, bilateral mastectomy, and cleft lip and palate. Furthermore, breast ptosis was considered to be closer to 'perfect health' than monocular blindness, binocular blindness, facial disfigurement requiring face transplantation surgery, unilateral facial paralysis and severe lower extremity lymphedema.

CONCLUSIONS: Quantifying the health burden of living with breast ptosis requiring mastopexy indicated that is comparable with other breast-related conditions (breast hypertrophy and bilateral mastectomy). Numerical values have been assigned to this health state (VAS: 0.80 ± 0.14 ; TTO: 0.87 ± 0.18 ; and SG: 0.90 ± 0.14), which can be used to form comparisons with the health burden of living with other disease states.

Key Words: Breast ptosis; Health state preference; Mastopexy; Utility score

Several factors can contribute to diminished elasticity of the breast over time, which, in turn, can result in breast ptosis. True ptosis occurs when the nipple-areola complex is below the level of the inframammary fold (1). Mastopexy is a procedure performed to modify the size, contour and elevation of sagging breasts without changing breast volume (2,3). Its goal is to restore a natural and youthful appearance to the breast that can either be performed as a standalone breast lift procedure, or in combination with breast augmentation or reduction mammoplasty (1,4,5). Mastopexy has traditionally used skin excision

La mastopexie de la ptose mammaire : les résultats utilitaires des préférences en population

HISTORIQUE : La ptose mammaire découle du vieillissement, d'une perte de poids et de l'allaitement. La mastopexie est une intervention utilisée pour modifier la taille, le contour et l'élévation des seins affaissés sans en modifier le volume. Pour en savoir plus sur le fardeau d'une ptose mammaire exigeant une mastectomie sur la santé, on peut utiliser des mesures validées pour la comparer à d'autres états de santé.

OBJECTIF : Quantifier l'évaluation utilitaire de l'état de santé des personnes qui présentent une ptose mammaire et qui profiteraient d'une mastopexie et déterminer si les scores d'utilité varient selon la démographie des participants.

MÉTHODOLOGIE : Les chercheurs ont utilisé des évaluations utilitaires au moyen d'une échelle analogique visuelle (ÉAV), de l'arbitrage temporel (AT) et de la méthode du pari standard (PS) pour obtenir les scores d'utilité de la ptose mammaire, de la cécité monoculaire et de la cécité binoculaire d'un échantillon de la population générale et d'étudiants dans une profession médicale. La régression linéaire et le test *t* de Student ont été utilisés pour l'analyse statistique. $P < 0,05$ était considéré comme statistiquement significatif.

RÉSULTATS : Les mesures moyennes ($\pm$ ÉT) de la ptose mammaire de 107 volontaires (ÉAV : $0,80 \pm 0,14$, AT : $0,87 \pm 0,18$, PS : $0,90 \pm 0,14$) étaient statistiquement différentes ($P < 0,0001$) des mesures correspondantes de cécité monoculaire et de cécité binoculaire. Par rapport à un échantillon en population, des connaissances médicales démontraient une différence statistiquement significative dans la moins grande susceptibilité à échanger des années de vie et à parier sur le risque d'une intervention comme la mastopexie. La race et le sexe n'étaient pas statistiquement significatifs, quels que soient les prédicteurs d'acceptation du risque.

EXPOSÉ : Pour la première fois, le fardeau de la ptose mammaire exigeant une intervention chirurgicale a été établi au moyen de mesures validées (ÉAV, AT et PS). Ainsi, le fardeau de la ptose mammaire sur la santé était comparable à celui de l'hypertrophie mammaire, de la mastectomie unilatérale, de la mastectomie bilatérale et de la fente labiopalatine. Par ailleurs, la ptose mammaire était considérée comme plus près de la « santé parfaite » que la cécité monoculaire, la cécité binoculaire, la défiguration exigeant une transplantation faciale, une paralysie faciale unilatérale et un lymphœdème des membres inférieurs.

CONCLUSIONS : La quantification du fardeau de la ptose mammaire exigeant une mastopexie sur la santé est comparable à d'autres problèmes mammaires (hypertrophie mammaire et mastectomie bilatérale). Des valeurs numériques ont été attribuées à cet état de santé (ÉAV : $0,80 \pm 0,14$, AT : $0,87 \pm 0,18$ et PS : $0,90 \pm 0,14$), et peuvent être utilisées pour former des comparaisons avec le fardeau d'autres états pathologiques sur la santé.

techniques including crescent, periareolar and inverted T designs to tighten the skin brassiere and elevate the nipple-areola complex; however, there is now emphasis being placed on internal shaping of the parenchyma (1,3,6-12). Depending on the degree of breast ptosis and according to Regnault's classification, the type of mastopexy performed can be determined (3,13). A major drawback of this procedure is that it can leave an unattractive scar; as such, trading a sagging breast for a breast that is visibly scarred can present a dilemma (1). Other common complications associated with this procedure include

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Figure 1) Patient with grade III breast ptosis requiring mastopexy: Image shown to prospective participants

nipple asymmetry, nipple necrosis, fat necrosis and skin necrosis (14). Furthermore, following glandular reshaping, microcalcifications can appear on mammography that, fortunately, can be distinguished from malignancy (3).

In mild to moderate ptosis, the limited scar mastopexy technique can be implemented with excellent outcomes. However, in severe cases, a Wise pattern breast reduction is the most feasible option and produces reliable results (15,16). The most common type of mastopexy performed by plastic surgeons in the United States is skin excision involving the inverted T incision; however, this is reportedly most prone to developing 'bottoming out'. Short-scar circumvertical incisions result in the highest physician satisfaction but the largest number of cases of asymmetry, and periareolar incisions produce the greatest rate of return to the operating room for a revision procedure (3,17). To gain more knowledge on the health burden of living with breast ptosis requiring mastopexy, validated measures can be used to compare it with other health states.

The most commonly used tools for utility assessment in outcomes research include the visual analogue scale (VAS), time trade-off (TTO) and standard gamble (SG) methods. They are used together to reduce the possibility of fault from any single measure (18-20). The utility scores ascertained using these tools are translated into a numerical value ranging from 0 (death) to 1 (perfect health) using a special algorithm (21-26). These tools have been used previously to assess outcomes for many different conditions (21,23-33). The VAS involves visualizing being in the given health state and providing a numerical score from 0 (death) to 1 (perfect health). TTO examines willingness to either trade years of life to live in perfect health (in this case, by undergoing a mastopexy procedure) or to live a set number of years in the described health state (breast ptosis). Similarly, SG provides a choice between either gambling with a degree of success (undergoing a mastopexy procedure) to attain perfect health or failure, or choosing to stay in the current health state (breast ptosis) (18,34,35). Not only can utility outcome scores aid in the comparison of the health burden of living with different conditions, but they can also be used in cost-effectiveness analysis and proper resource allocation, as well as the surgical decision-making process (26,28,36). The goal of the present study was to quantify the health state utility assessment of individuals living with breast ptosis who could benefit from a mastopexy procedure and to determine whether utility scores vary according to participant demographics.

METHODS

A photograph of the given health state (breast ptosis requiring mastopexy) was shown to volunteers from a sample of the general population

and medical student volunteers who were prospectively recruited through online classified ads on www.kijiji.ca and www.craigslist.org to a utility assessment website. Medical students at McGill University (Montreal, Quebec) were also sent e-mails. They were asked to complete questionnaires on all three utility outcome tools (ie, VAS, TTO and SG) to ascertain the health state preference of living with breast ptosis. The respondents were not given structured scenarios because the authors did not want to detract from the primary goal of the study, which was to investigate the health state burden of living with breast ptosis or to introduce observer bias. This was done to simplify comprehension of the study as well as to standardize the outcomes to allow a fair comparison with previously published utility outcomes scores. An incentive in the form of a raffle with a chance to win \$1,000 was offered for participation. Rating of monocular and binocular blindness was used to evaluate the comprehension capacity of volunteers in the present study. Participants were asked to appropriately rank binocular blindness (having lower utility score or a health state closer to death) and monocular blindness. Those who ranked binocular blindness as having a higher utility (closer to perfect health) than monocular blindness were excluded from the study. Furthermore, it aided the standardization of the scores assigned to the given health state. Three different measures were used: VAS, TTO and SG.

In the VAS, study participants were asked to 'visualize' themselves in the given health state (breast ptosis) and to assign a value on a slide bar scale from 0 (death) to 100 (perfect health). A utility score was then determined: utility health state = score/100. The TTO assessment asked participants to select between either 'trading off' a certain number of years to live in perfect health or to live a set number of years in the described health state (breast ptosis). The number of years 'traded off' was then varied using a bisecting search routine until the indifference point was found:

$$\text{Utility} = \frac{(\text{number of years specified in the described health state} - \text{number of years traded off at the indifference point})}{\text{number of years specified in the described health state}}$$

In the SG test, participants were given the choice to either take a chance (ie, gamble with some probability of success to attain perfect health; that is, to undergo a mastopexy procedure) and some probability of failure (death) or to remain in a given health state. Success and failure were then varied as percentages until the subject was indifferent about whether to remain in the given health state or to take a gamble. The utility score was calculated (27,37):

$$\text{Utility health state} = \frac{(1.00 - \text{risk of death at the point of indifference})}{100}$$

All study participants signed an electronic consent form. Consent was also obtained from the patient to allow her photograph to be used (Figure 1); this was mandated for approval by the Institutional Review Board at McGill University, which approved the present study. At the end of the questionnaire, demographic information, including age, sex, race, level of education and annual income, were obtained from the study volunteers.

Statistical analysis

Continuous variables were compared using paired and independent *t* tests. Categorical variables were compared using the χ^2 test. To evaluate utility outcome measures while controlling for potential independent risk factors (age, sex, race and education), a linear regression model was used; $P < 0.05$ was considered to be statistically significant. All statistics were ascertained using SPSS (IBM Corporation, USA) for Windows (Microsoft Corporation, USA) and PASW Statistics release 18.0.0 (IBM Corporation, USA).

RESULTS

A total of 118 volunteers participated in the present study. One hundred seven participants ranked monocular blindness higher than binocular

TABLE 1
Utility scores of breast ptosis deformity comparing medical students and the general population after regression analysis

Utility score	Medical students	General population	P*
Visual analogue scale	0.79±0.18	0.79±0.20	0.590
Time trade-off	0.96±0.01	0.88±0.19	0.022
Standard gamble	0.95±0.05	0.89±0.15	0.024

Data presented as mean ± SD unless otherwise indicated. *t test

TABLE 2
Utility scores for breast ptosis deformity comparing race

Utility score	Caucasian	Non-Caucasian	P*
Visual analogue scale	0.78±0.21	0.81±0.18	0.33
Time trade-off	0.89±0.17	0.87±0.20	0.55
Standard gamble	0.91±0.13	0.89±0.16	0.37

Data presented as mean ± SD unless otherwise indicated. *t test

TABLE 3
Utility scores for breast ptosis deformity comparing sex

Utility score	Male	Female	P*
Visual analogue scale	0.79±0.16	0.79±0.21	0.584
Time trade-off	0.88±0.22	0.89±0.18	0.735
Standard gamble	0.92±0.13	0.90±0.14	0.751

Data presented as mean ± SD unless otherwise indicated. *t test

blindness and were included; 11 did not and were, therefore, excluded from the present study. Mean (± SD) utility scores for living with breast ptosis requiring mastopexy were 0.80±0.14, 0.87±0.18 and 0.90±0.14 for VAS, TTO and SG, respectively, which was significantly higher than scores for monocular blindness (0.60±0.28, 0.82±0.16 and 0.87±0.14, respectively) and binocular blindness (0.34±0.18, 0.62±0.27 and 0.60±0.28) (VAS P<0.0001; TTO P<0.0001; SG P<0.0001). Based on these utility outcomes, if presented with breast ptosis, the participant population would have been willing to trade 4.6 years of their life and risk a 10% chance of death from a procedure such as mastopexy. Linear regression however, determined that education, specifically medical education, was the only statistically significant factor (TTO P=0.022; SG P=0.024). Participants with a medical background were less likely to gamble with the risk for death and were less willing to trade years of life to undergo a mastopexy (Table 1). Other independent predictors of risk were not found to be statistically significant: race (VAS P=0.33; TTO P=0.55; SG P=0.37) (Table 2) and sex (VAS P=0.584; TTO P=0.735; SG P=0.751) (Table 3). Of the 107 volunteers who participated in the present study, most were Caucasian (57.9%), female (75.7%), 25.4±10.1 years of age and had no formal medical education but did attend college (34.6%) and earned >\$10,000 (69.5%) annually. Participant demographics are presented in Table 4.

DISCUSSION

Mastopexy can prove to be a challenging procedure due to the ptotic and lax tissue exhibited by a sagging breast. It requires meticulous planning and a careful approach, regardless of which the desired outcome may not be reached (15). The ultimate goal is to correct breast ptosis and construct an aesthetically pleasing breast. Although numerous options exist, it is by no means an easy task (15). Recent advances have improved traditional approaches to mastopexy, which have long placed emphasis on the excision of skin with minimal manipulation of the parenchyma (3). Unlike reduction mammoplasties, tissue is rarely removed but, rather, can be redistributed to restore a youthful-appearing breast (15). Goes (38) suggested that skin excisions alone do not prevent ptosis. He proposed repositioning breast connective structures, treating the glandular tissue as a separate entity from the

TABLE 4
Participant demographics

Characteristic	
Age, years, mean ± SD	25.4±10.1
Sex	
Male	26 (24.3)
Female	81 (75.7)
Race	
Caucasian	62 (57.9)
Non-Caucasian	45 (42.1)
Hispanic	1 (0.9)
Asian	8 (7.5)
Other	34 (33.7)
Education	
Medical education	10 (9.3)
Nonmedical education	97 (90.6)
High school	4 (3.7)
Some college	37 (34.6)
College graduate	13 (12.1)
Prefer not to answer	31 (29)
Annual income, \$	
<10,000	39 (30.5)
≥10,000	89 (69.5)
10,000–25,000	11 (8.6)
>25,000–50,000	4 (3.1)
>50,000–100,000	1 (0.8)
>100,000	1 (0.8)
Prefer not to answer	72 (56.2)

Data presented as n (%) unless otherwise indicated

cutaneous lining and supplementing it with a circular flap of dermis. The double flap technique described by Foustanos and Zavrides (39) incorporates the inverted T incision pattern, in which a parenchymal flap (based on chest wall-perforating vessels), a medial pillar and a lateral pillar are created. The flap is sutured to the pectoral fascia and the pillars are sutured together. Similarly, an inverted or vertical T incision was performed by Ritz et al (40) for the fascial suspension mastopexy technique. More recently, Kelemen et al (41) suggested an inferior pedicle technique with attention devoted to volume redistribution by skin taking the tension for the entire breast rather than focusing on elevating the nipple position and skin excision. Furthermore, the use of acellular dermal matrices in mastopexy has been explored (42).

One of the main issues with mastopexy is that the procedure is not possible without the placement of incisions to the breast, which may be more or less visible depending on the site. In certain instances, a hypertrophic scar may form, which may compromise the final appearance, making the decision to undergo mastopexy more difficult.

For the first time, the burden of living with breast ptosis requiring surgical intervention was investigated using validated metrics (VAS, TTO and SG) (18,27,37). The primary advantage of using these utility indexes is their ability to provide scientific evidence relating treatment end results to impact on society (43,44). Moreover, they may be used to highlight various shortcomings in clinical practice, which, in turn, may aid in the development of standard of care (43,44). In this way, evidence-based rationale for treatments can be implemented. Furthermore, insurance and health care agencies can recognize improved cost-benefit options for the purposes of disease prevention (43-45). Despite this, the underlying assumptions and methodological issues related to utility scores have, in fact, been questioned. Issues regarding the theoretical foundation of the approach and their failure to take into account all dimensions of health benefits have been raised. These utility measures also fall short in accounting for equity weights, which may result in difficulties for public health interventions (46). Nevertheless, these scores can be used to offer patients a numerical comparison with other

TABLE 5
Comparison of utility scores for breast ptosis with other conditions

Plastic surgical condition (ref)	VAS	TTO	SG
Breast ptosis deformity	0.80±0.14	0.87±0.18	0.90±0.14
Unilateral mastectomy (45)	0.75±0.17	0.87±0.15	0.86±0.18
Bilateral mastectomy (44)	0.70 ±0.18	0.85 ±0.16	0.86±0.17
Cleft lip and palate (22)	0.69±0.18	0.85±0.16	0.84±0.18
Monocular blindness (26)	0.60±0.28	0.82±0.16	0.87±0.14
Binocular blindness (26)	0.34±0.18	0.62±0.27	0.60±0.28
Facial disfigurement requiring facial transplantation (26)	0.46±0.02	0.68±0.03	0.66±0.03
Unilateral facial paralysis (23)	0.56±0.18	0.76±0.22	0.79±0.21
Lower extremity lymphedema (33)	0.50±0.18	0.76±0.22	0.76±0.21
Aging neck needing rejuvenation (25)	0.89±0.07	0.94±0.08	0.95±0.10

Data presented mean ± SD. ref Reference; SG Standard gamble; TTO Time trade off; VAS Visual analogue scale

related procedures, thus improving the shared decision-making experience and aiding patients' understanding of their anticipated quality of life. The goal of the present study was to calculate utility scores of this health state using methods that have been previously validated from the perspective of society as a whole rather than from a subset of patients (18,27,31,37). The societal perspective, as previously reported, serves as a better measure for analysis of cost effectiveness and is directed at decision makers representing this population. It has been suggested that as institutions, such as the national health insurance, health-systems agencies and health-maintenance organizations, place more emphasis on the societal perspective, the significance and value of cost-effectiveness analysis will increase even more (36).

Statistical analyses showed that sex, ethnicity and annual income were not independent predictors of utility scores in breast ptosis. That is to say, these variables did not vary in our study population's perception of living with breast ptosis. Medical education, however, was significant, indicating that individuals with a medical background would choose not to seek treatment for breast ptosis but rather prefer to live in the current health state. This may be due to the fact that a majority of the participants were female who would prefer to avoid the possibility of developing a visible scar following mastopexy, which may diminish the aesthetic appearance of the breast (3,14,15).

The health burden of living with breast ptosis (VAS: 0.80±0.14; TTO: 0.87±0.18; and SG: 0.90±0.14) was found to be comparable with that of breast hypertrophy (TTO: 0.85), unilateral mastectomy (TTO: 0.87±0.15), bilateral mastectomy (TTO: 0.85), cleft lip and palate (TTO: 0.85±0.16; and SG: 0.84±0.18), as well as erectile dysfunction (TTO: 0.89) (22,30,31,47,48). Furthermore, it is considered to be closer to 'perfect health' than monocular blindness (VAS: 0.60±0.28; TTO: 0.82±0.16; SG: 0.87±0.14), binocular blindness (VAS: 0.34±0.18; TTO: 0.62±0.27; SG: 0.60±0.28), having HIV stage II (VAS: 0.59; TTO: 0.75; SG: 0.50), being on hemodialysis (VAS: 0.77; TTO: 0.73; SG 0.91), peritoneal dialysis (VAS: 0.79; TTO: 0.56; SG 0.81) or having undergone renal transplantation (VAS: 0.86; TTO: 0.84) after being diagnosed with end-stage renal disease, facial disfigurement requiring face transplantation surgery (VAS: 0.46±0.02; TTO: 0.68±0.03; SG: 0.66±0.03), unilateral facial paralysis (VAS: 0.56±0.18; TTO: 0.78±0.21; SG: 0.79±0.21), and severe lower extremity lymphedema (VAS: 0.50±0.18; TTO: 0.76±0.22; SG: 0.76±0.21) (23,26-28,33,49-51) (Table 5). However, it is closer to a state of 'mortality' than aging neck deformity following massive weight loss (VAS: 0.89±0.07; TTO: 0.94±0.08; SG: 0.95±0.10) and obstructive sleep apnea syndrome (TTO: 0.94; SG: 0.97) (Table 5) (25,32). If given the option to undergo mastopexy as a means to treat breast ptosis, our study population would be willing to risk a hypothetical 10% chance of death and trade 4.6 years of life in an attempt to attain 'perfect health'.

Limitations of our study included our sample population possibly not being representative of society as a whole, and the fact that mastopexy is not a disease state per se. However, these limitations may be overcome by our large sample size and by not including patients who could not comprehend the study design. To avoid the biasing effect of phrasing every question in terms of the risk of death, every statement was rephrased in terms of the probability of living in perfect health (52). When interpreting these data, it is crucial and vitally important to consider that the assigned numerical values are meant to enable quantitative comparisons among disease states rather than suggesting a definitive mortality rate for undergoing a procedure. Furthermore, the data obtained in the present study were not specifically derived from women undergoing mastopexy. It was also for this reason that practicing plastic surgeons were not surveyed; bias may place further value on mastopexy, which, may in turn, be relevant for financial coverage for this procedure resulting in conflict of interest. Perhaps recruiting more participants with a background in medicine with a strong understanding of the risks associated with surgical procedures would provide additional information regarding the impact of education on the perceived utility of mastopexy. There were no data obtained on the occupation of participants who were members of the general population, which would have improved our analyses. Finally, the data collected did not permit an analysis of the monetary value that the participants would pay for mastopexy, but is certainly an issue that should be taken into account for future utility outcome studies. By quantifying the health burden of living with breast ptosis requiring treatment, informed comparisons can easily be made with other health states, which will improve both the surgeons' and the patients' knowledge regarding the quality of life expected when a patient consents to a specific procedure.

CONCLUSIONS

We quantified the health burden of living with breast ptosis requiring mastopexy, indicating that is comparable with other breast-related conditions (breast hypertrophy and bilateral mastectomy). A numerical value was assigned to this health state (VAS: 0.80±0.14; TTO: 0.87±0.18; SG: 0.90±0.14), which can be used to make comparisons with the health burden of living with other disease states.

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